"IMPACT OF PRE AND POST OPERATIVE BEDSIDE PULMONARY FUNCTION TEST ON THORACOTOMY PATIENT"

– A COMPARATIVE STUDY "

A project submitted towards partial fulfilment of the requirements of for the degree of

MASTER OF PHYSIOTHERAPY

Submitted by
Register number: 271730203

under the guidance of
PROF. B. SUBASHINI MPT (CARDIO)

Submitted to
THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY
Chennai – 32

P.P.G. COLLEGE OF PHYSIOTHERAPY
9/1, Keeranatham road,
Saravanampatti ,
Coimbatore – 641035

May – 2019

“IMPACT OF PRE AND POST OPERATIVE BEDSIDE PULMONARY FUNCTION TEST ON THORACOTOMY PATIENT”

– A COMPARATIVE STUDY ”

INTERNAL EXAMINER :

EXTERNAL EXAMINER :

A project submitted in partial fulfilment
of the requirement for the degree of

MASTER OF PHYSIOTHERAPY

To

THE TAMILNADU Dr. M. G. R. MEDICAL UNIVERSITY, CHENNAI-32

MAY 2019

CERTIFICATE I

This is to certify that the dissertation entitled **"IMPACT OF PRE AND POST OPERATIVE BEDSIDE PULMONARY FUNCTION TEST ON THORACOTOMY PATIENT – A COMAPARATIVE STUDY "** was carried out by **Reg. No. 271710203, P.P.G College of Physiotherapy, Coimbatore-35,** affiliated to the **Tamilnadu Dr.M.G.R medical university, Chennai-32, under the guidance of Prof. B. SUBASHINI MPT (CARDIO)**

PRINCIPAL
Prof. Dr. C. SIVA KUMAR
MPT (ORTHO), MIAP, Ph.D.

CERTIFICATE II

This is to certify that the dissertation entitled **"IMPACT OF PRE AND POST OPERATIVE BEDSIDE PULMONARY FUNCTION TEST ON THORACOTOMY PATIENT – A COMAPARATIVE STUDY "** was carried out by **Reg. No. 271710203, P.P.G College of Physiotherapy, Coimbatore-35,** affiliated to the **Tamilnadu Dr.M.G.R medical university, Chennai-32,** under my guidance and direct submission.

GUIDE

Prof. B. SUBASHINI MPT (CARDIO)

ACKNOWLEDGEMENT

I thank **GOD**, the almighty who laid the foundation for knowledge and wisdom and has always been my source of strength and inspiration.

I thank my **PARENTS**, who had given me the opportunity, guidance, encouragement and support throughout the course of my study.

I Express my sincere gratefulness to our Chairman **Dr L.P.THANGAVELU, M.S, F.R.C.S** and our correspondent **MRS.SHANTHI THANGAVELU, M.A** P.P.G. Group of Institutions, Coimbatore, for their encouragement and providing the source for the successful of the study.

I express my sincere gratefulness to My principal Prof. **Dr. C. SIVA KUMAR, MPT(Ortho), MIAP, Ph.D.,** who gave me his precious time and his guidance and encouragement helped me to complete this dissertation successfully.

I extend my sincere thanks to **Prof. B. SUBASHINI MPT (CARDIO)**, for assisting me with valuable inputs and guiding me through the course of my work.

The gratitude I have for each and every **SUBJECTS** who participated in this study is beyond expression. Their whole hearted cooperation is easily the biggest reason of all, for this study to be what it is.

I extend my thanks to **MY FRIENDS** for their support and constant encouragement throughout this project.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

"IMPACT OF PRE AND POST OPERATIVE BEDSIDE PULMONARY FUNCTION TEST ON THORACOTOMY PATIENT – A COMPARATIVE STUDY "

CHAPTER I

1.1 INTRODUCTION

Pulmonary function tests (PFTs) are breathing test to find out how well you move air in out of your lung and how well oxygen enters your body. The most common PFTs are Spirometry, diffusion study and body plesmethography. Sometime only one test is done, often on same day.[(1)]

Pulmonary function testing and monitoring plays an important role in respiratory evaluation. A complete bedside evaluation of the respiratory status is especially useful in preoperative assessment. Bedside traditional tool to assess pulmonary gas exchange such as arterial or transcutaneous blood gas analysis, pulse oxymetry and additional valuable information about global lung function is provided through measurement of pulmonary mechanics and volume. [(2)]

PFTs have been progressed from initially used water seal types to modern era electronic computerized version. They are patient friendly and easier to understand. Pulmonary function test can be carried out at bedside in critically ill patient with the help of portable spirometer in addition to the routine clinical test. If the PFTs are done with quality assurance,validation of equipment, proper technique, reference values and applying right ethnic correction factors, the data generated are most of the times accurate and reproducible. [(3)]

PFTs can be used to:

Compare your lung function with known standards that shows how well your lungs should be working, Measure the effect of chronic diseases like asthma, chronic obstructive lung diseases (COPD) or cystic fibrosis on Lung Function, Identify early changes in lung Function that might show a need for a change in treatment, Detect narrowing in the airways, Decide if a medicine could be helpful to use, Show whether exposure to substance in your home or workplace have harmed your Lungs, Determine your ability to tolerate surgery and medical procedures.

Spirometry is one of the most common lung function tests. The spirometer measure how much air you can breathe into your lung and how much air you quickly blow out of your lungs. To get the "best" test result, the test is repeated thrice. [(1)]

Author Hamid Hassanzadeh hypothesized that the use of incentive Spirometry by patients is less than the recommended level and is affected by patient related factor and type of surgery. To determine its post operative use the author prospectively surveyed all patients in their institutions general ward who had under gone thoracotomy Compliance with incentive spirometry use in the patient population was poor and was largely influenced by type of surgery performed and postoperative day. Because of postoperative complication such as atelectesis, fever and pneumonia continue to affect outcomes after thoracotomy, a need exists for improved preoperative and in hospital counseling strategies regarding incentive spirometery use and for objective measurements for monitoring incentive spirometry use and potential confounding variables. [(4)]

Pulmonary complication were defined as the development of 3 or more of 6 new findings: cough, phlegm, dyspnea, chest pain, temperature greater than 38 degree C, pulse rate more than 100 beats/min. [(5)]

Postoperative complication like fever and leuckocytosis are common after joint replacement. A study conducted by Borger JE et al. to determine the incidence of fever and leucocytosis after joint replacement. He found that after joint replacement more than half of patients develop leucocytosis and some develop fever. [(6)]

Pulmonary Complication occurs in 20% to 40% of patients following abdominal and thoracic operations making pulmonary complication the single largest cause of morbidity and mortality in the postoperative period. The prophylactic respiratory maneuver is one of many aspects of post-operative care that are intended to minimize pulmonary complications. Various respiratory maneuver and devices to encourage those maneuvers are used. [(7)]

In most of the surgery intraoperative pulmonary changes are due to decreased pulmonary compliance secondary to upward movement of the diaphragm during insufflations and to changes in carbon dioxide homeostasis secondary to absorption of insufflated CO_2 from peritoneum. General anesthesia and surgery related pain may

lead to changes in the ventilation pattern resulting in the patient taking shallow breath which reduce the ability to clear sputum from the chest. [8]

INCENTIVE SPIROMETERY

Mechanical breathing device such as the incentive spirometery has been introduced into clinical practice. Incentive spirometry encourages the patient to take long, slow deep breath mimicking natural sighing and also provides a visual positive feedback. [8]

Incentive spirometer is available either by volume of inspiration (volume oriented) or flow rate (flow oriented). The flow-oriented incentive spirometer (Triflow device) consists of three chambers in series, each of which contains a ball. When the patient effort generates a subatmosphere pressure above the ball. It rises in the chamber in series, each of which contains the ball. When the patient's effort generates a subatmosphere pressure above the ball, it rises in the chamber. An inspiratory flow of 600mL/s is required to raise the first ball, an inspiratory flow of 900mL/s is required to elevate the first and second balls, and a flow of 1200 mL/s is required to elevate all three balls. [8]

The volume-oriented incentive spirometer is a compact device of 4000mL capacity and has a one-way valve to prevent exhalation into the unit. A sliding pointer indicates the prescribed inspiratory volume and an inspiratory flowguide coaches the subject to inhale slowly. [8]

Incentive spirometer is mechanical device that were originally introduce in surgical patient in an attempt to reduce postoperative pulmonary complications, by increasing inspiratory capacity. The device is activated by patient inspiratory effort. When a slow deep inspiration is performed, with the lips sealed around the mouthpiece, the ongoing inspiration is motivated by visual feedback, for example a ball is rising to a preset marker. A patient aim to predetermine flow or to achieve a preset volume and is encourage to hold at full inspiration for 2-3 sec. [9]

A short, sharp inspiration can activate the flow generated incentive spirometry devices with a volume-dependent device an increase in tidal volume must be achieved before the preset level can be reached. The increased work of breathing required should be considered in patient at risk of inspiratory muscle fatigue and in patient with severely

impaired respiratory muscle function. Spirometer with a low imposed work of breathing should be considered, if appropriate for these groups, and in some postoperative patient. [9]

The pattern of breathing while using an incentive spirometer is important. Expansion of the lower chest should be emphasized rather than the use of the accessory muscle of respiration, which would encourage expansion of the upper chest. Diaphragmatic movement is thought to be an important factor in the prevention of postoperative pulmonary complication. Incentive spirometry has been shown to increase abdominal movement in normal subjects, but not in subject following abdominal surgery. [9]

There may be a place for the use of spirometry, to increase lung volume following surgery, in children and in some adolescent to provide motivation and in patient who are immobilized, but with significant advances in anesthesia and surgery ambulation may be the ‘treatment’ of choice for the majority of patient who are able to mobilize postoperatively.

BREATH HOLDING TIME:

This is a semi-objective measure that generally shows a direct relationship between the maximum breath holding time (BHT) and the resting PaCO2 (short breath holding time is usually associated with a low or unstable resting PaCO2). BHT tends to increase as the breathing pattern becomes more regular and stable. The patient is given a description of the method and then asked to take a normal breath out and to hold the breath in the resting phase until it becomes too uncomfortable to hold any longer. This breath-holding after a full inspiration and a full expiration. Whichever method is used, it is essential to use a similar process and similar posture each time. [(9)]

Standardization of the procedure would be helpful. The average BHT is suggested to be approximately 30 seconds. The patient will hope to increase the BHT if it is low but it is not helpful to know the norm at this time, as it may cause a forced hold time, which could damaging to the process. If breath-holding time is recorded at regular intervals it could be use as a semi-objective outcome measure. [(9)]

Breath-holding is a voluntary act, but normal subjects appear unable to breath-hold to unconsciousness. A powerful involuntary mechanism normally overrides voluntary breath-holding and causes the breath that defines the breakpoint. The occurrence of the breakpoint breath does not appear to be caused solely by a mechanism involving lung or chest shrinkage, partial pressures of blood gases or the carotid arterial chemoreceptors. This is despite the well-known properties of breath-hold duration being prolonged by large lung inflations, hyperoxia and hypocapnia and being shortened by the converse manoeuvres and by increased metabolic rate. Breath-holding has, however, two much less well-known but important properties. First, the central respiratory rhythm appears to continue throughout breath-holding. Humans cannot therefore stop their central respiratory rhythm voluntarily. Instead, they merely suppress expression of their central respiratory rhythm and voluntarily ‘hold’ the chest at a chosen volume, possibly assisted by some tonic diaphragm activity. Second, breath-hold duration is prolonged by bilateral paralysis of the phrenic or vagus nerves. Possibly the contribution to the breakpoint from stimulation of diaphragm muscle chemoreceptors is greater than has previously been considered. At present there is no simple explanation for the breakpoint that encompasses all these properties. [(10)]

Normal :Greater than 25sec

Borderline :15-25 sec

Severe :Less than 15sec

The preoperative physical function of a patient is an independent predictor of postoperative morbidity and mortality. The advent of surgical stress often leads to a substantial decrease in physical functioning through different pathways. In addition, prolonged periods of physical inactivity in the post- operative phase induce loss of muscle mass, cardiopulmonary deconditioning, pulmonary complications, and psychological distress. These phenomena may result in a decreased quality of life postoperatively, increased morbidity, and occasionally premature de

Several studies have shown that the pre operative aerobic capacity of lung patient correlates with the rate of post operative pulmonary complication. Some study finding imply that optimal preoperative physical functioning of patient can be important determinant of postoperative functioning, complication rate and length of hospital stay. **(11)**

However failure to stabilize the medical condition prior to surgery increases the risk of post operative cardiac and pulmonary complication. Physician should therefore strike a balance between early surgery and adequate preoperative assessment and intervention in order to achieve better outcomes and reduce the complications. **(12)**

1.2 NEED OF THE STUDY

The current study aimed to observe whether the patient can maintain the vital capacity of the lungs after the surgery. The study signify that pulmonary function are compromised after the surgery and how we can minimize the post operative complication of the surgery over the pulmonary function and improve the function to the prior level with the help of incentive spirometer and breath holding manure. Physiotherapy plays a major role to prevent operative complications of the surgery.

1.3 AIM OF STUDY

AIM: The aim of the study was to find the impact of Pre and Post operative bedside Pulmonary function test on Thoracotomy patient.

1.4 OBJECTIVES OF THE STUDY

- To find out the pre operative bedside pulmonary function test on the patient undergone Thoracotomy .
- To find out the post operative bedside pulmonary function test at days 1, 3 and 7 on patient undergone Thoracotomy .
- To compare the difference between pre and post operative changes in pulmonary function at days 1, 3 and 7 on Thoracotomy patient.

1.5 HYPOTHESIS

NULL HYPOTHESIS: there will be no significant effect on pulmonary function before and after Thoracotomy

ALTERNATE HYPOTHESIS: There will we significant effect on pulmonary function before and after Thoracotomy

CHAPTER II

REVIEW OF LITERATURE

Heo HM et al (2018) found that 46 patients (44 men, 2 women) were randomized to the combination group (ISE plus CE; n=23) or the CE group (n=23). The CE regimen of both groups consisted of 20 exercises performed for 30 min once a day. The ISE was performed once a day for 30 min. The trial duration was 16 weeks. Patients were assessed before and at the end of treatment by measuring the Bath Ankylosing Spondylitis Disease Activity Index, Bath Ankylosing Spondylitis Functional Index (BASFI), chest expansion, finger to floor distance, pulmonary function measures, and 6-min walk distance. Both groups improved significantly in terms of chest expansion ($p<0.01$), finger to floor distance ($p<0.01$), and BASFI ($p<0.05$) after completing the exercise program. However, only the combination group showed significant improvements in the forced vital capacity ($p<0.05$), total lung capacity ($p<0.01$), and vital capacity ($p<0.05$).

Peter O. Newton et al (2018) found that some patients with adolescent idiopathic scoliosis may have clinically relevant pulmonary impairment that is out of proportion with the severity of the scoliosis, and this may alter the decision-making process regarding which fusion technique will produce an acceptable clinical result with the least additional effect on pulmonary function.

Hamid Hassanzadeh, MD Amit Jain et al (2017) found that the use of incentive spirometry by patients is less than the recommended level and is affected by patient-related factors and type of surgery. To determine its postoperative use, the authors prospectively surveyed all patients in their institution's general Surgical ward who had undergone elective spine surgery or thoracotomy during a consecutive 3-month period in 2010, excluding patients with postoperative delirium or requiring a monitored bed. All 182 patients (74 men, 108 women; average age, 64.5 years; range, 32-88 years; spine group, n555; arthroplasty group, n5127), per protocol, received preoperative spirometry education by a licensed respiratory therapist (recommended use, 10 times hourly) and reinforcement education by nurses. Patients were asked twice daily (morning and evening) regarding their spirometry use during the previous 1-hour period by a registered nurse on postoperative days 1 through 3. All data were collected by the same 2 nurses using the same standardized questionnaire. Spirometry

use was correlated with surgery type, postoperative day/time, and patient's age and sex. Student's *t* test, Spearman test, and one-way analysis of variance were used to compare differences (*P*,.05). Spirometry use averaged 4.1 times per hour (range, 0-10 times). No statistical correlations were found between spirometry use and age. Sex did not influence spirometry use. The arthroplasty group reported significantly higher use than did the spine group: 4.3 and 3.5 times per hour, respectively. Mean use increased significantly between postoperative days 1, 2, and 3.

D'Lima, **Darryl et al (2017)** found that the effects of preoperative physical therapy or general cardiovascular conditioning exercises with the routine procedure of no preoperative physical therapy on patients undergoing primary thoracotomy. Thirty patients were randomly assigned to 1 of 3 groups. Group 1 was the control group. Group 2 participated in a physical therapy program designed to strengthen the upper and lower limbs. Group 3 participated in a cardiovascular conditioning program, consisting of arm ergometry, cycle ergometry, aquatic exercises, and aerobic activity. All patients were evaluated preoperatively and postoperatively, the Arthritis Impact Measurement Scale, and the Quality of Well Being instrument. Both experimental groups tolerated their respective exercise protocols extremely well. All 3 groups showed significant improvement postoperatively

Lingard, Elizabeth et all (2017) found that patient who have marked functional limitation, severe pain , low mental health score, and other comorbid condition before total thoracotomy are more likely to have worse outcome atone year and two year postoperatively. After adjusting for these predictors, it was found that patient from the United Kingdom had significantly worse functional outcome but similar pain relief compared with those from the Unitied states and Australia. We recruited 860 patient and obtained one year WOMAC data in 759 patient (88%) and two year data on 701 (82%). The mean age was seventy years and 59% of the patient were female. Using hierarchial regression models, we found that most significant preoperative predictors of worse scores of pain and function domains of the WOMAC scale and on the physical functioning domain of the SF-36 at one and two years postoperativly were low preoperative scores, a higher number of comorbid conditions and a low SF-36 mental health score. After adjusting for these predictors, we found that functional status of the patients from the united kingdom was siginificantly worse than that

patient from the United kingdom was significantly year and two year follow up examination (p=0.025), the difference was not clinically important.

N.D.Clement, R.Burnett et al (2016) found that patient with a worse post operative generic physical health, and those with a sub-clinical improvement, will have a greater rate of dissatisfaction with thoracotomy. Prospectively complied data for ,primary thoracotomy were used. Patient demographics, comorbidity, and pre- and post-operative (1 year). Patient satisfaction was also assessed 1 year post-operatively. The satisfaction rate of patients with a poor post-operative SF-12 physical component summary (PCS score) (B40 points) and those with a subclinical improvement (4 points) in the score were compared to those with a score of more than and a clinically significant improvement, respectively.

Karin Valkenet, Ingrid GL van de Port (2016) found that Preoperative exercise therapy can be effective for reducing postoperative complication rates and length of hospital stay after cardiac or abdominal surgery. More research on the utility of preoperative exercise therapy and its long-term effects is needed as well as insight in the benefits of using risk models. Twelve studies of patients undergoing joint replacement, cardiac or abdominal surgery were included. The PEDro scores ranged from 4 to 8 points.Preoperative exercise therapy consisting of inspiratory muscle training or exercise training prior to cardiac or abdominal surgery led to a shorter hospital stay and reduced postoperative complication rates. By contrast, length of hospital stay and complication rates of patients after joint replacement surgery were not significantly affected by preoperative exercise therapy consisting of strength and/or mobility training.

M.Wong (2016) found that Hip fracture is a common injury among the elderly. Although patients who receive hip fracture surgery carry the best functional recovery compared to other treatment modalities, the presence of postoperative pulmonary complications, such as atelectasis, pneumonia, and pulmonary thromboembolism, may contribute to increased length of hospital stay, perioperative morbidity, and mortality. This review aims to provide evidence-based recommendations for preoperative assessment and perioperative strategies to reduce the risk of pulmonary complications after hip fracture surgery. Clinical assessment and basic laboratory results are sufficient to stratify the risk of postoperative pulmonary complications.

Well documented risk factors for pulmonary complications include advanced age, poor general health status, current infections, pre-existing cardiopulmonary diseases, hypoalbuminemia, and impaired renal function. Apart from optimizing the patient's medical conditions, interventions such as lung expansion maneuvers and he risk ofpulmonary complications after hip fracture surgery.

Daniel P. Lemanu, Primal P. Singh et al (2016) found the extent to which preoperative conditioning (PREHAB) improves physiologic function and whether it correlates Eight low- to medium-quality RCTs were included in the final analysis. The patients were elderly (mean age [60 years), and the exercise programs were significantly varied. Adherence to PREHAB was low. Only one study found that PREHAB led to significant improvement in physiologic function correlating with improved clinical outcomes.

Scott Ritterman, Lee E. Rubin et al (2016) Thoracotomy is the most common and successful elective surgeries performed in the United States each year. Preoperative medical preparation and postoperative rehabilitation are equally important to a successful outcome. Physical deconditioning, tobacco use, obesity and medical co-morbidities can adversely affect outcomes and should be addressed before any elective procedure. Formal postoperative therapy is geared towards the specific surgery and is aimed at returning the patient to independent activity.

Sjaak Powel,David Hagman et al (2015) it seems that PET exerts beneficial effects on physical fitness and postoperative out- come measures. Gapsin current literature is the heterogeneity in selected patient populations and outcome measures as well as lack of guidelines on the specific PET regimes. Therefore, there is increasing need for multicenter and randomized trials with specifically designed PET programs and a carefully selected patient population to strengthen current evidence. Two authors independently conducted a comprehensive literature search on systematic reviews regarding PET. The risk of bias was assessed using “the methodology checklist for systematic reviews and meta-analyses of the Scottish Intercollegiate Guidelines Network (SIGN).” Findings of the included systematic reviews were summarized

according to type of surgery and type of PET. Twenty-one reviews on PET with a low risk of bias were included. Seven reviews investigated PET in multiple surgical fields' and14 in just a single surgical field. PET was studied before cardiac surgery (n=9), orthopaedic surgery (n=8), abdominal surgery(n=8), thoracic surgery (n=8), vascular surgery(n=3), and urologic surgery (n=1).

Choudhary sumer et al (2015) found that Pulmonary function tests have progressed from initially used water seal types to modern era electronic computerized versions. The newer software are comparatively easier to operate and less time consuming. They arepatient friendly and easier to understand. However there are limitations to pulmonary function tests, as the patternof abnormality indicates type of problem however they do not provide anatomic diagnosis. Battery of tests isavailable which help in evaluation of different aspects of pulmonary function. It is possible to monitor theprogression of disease and effect of management. However no single test can evaluate all aspects of pulmonaryfunction. Pulmonary function test can be carried out at bedside in critically ill patients with the help of portablespirometers in addition to the routine clinical tests. Commonly performed pulmonary function tests are dynamicstudies –pre and post bronchodilator tests, evaluation of lung volumes with body plethysmography, nitrogenwashout or helium dilution methods, diffusion capacity of the lung carbon monoxide by single breath analysis,arterial blood gases and pulse oximetry. Other commonly performed tests are maximal expiratory and inspiratorypressure, exercise induced(Treadmill)or allergen induced bronchoprovocative tests, shunt studies and Dead with quality assurance, validation of the equipment,proper technique, reference values and applying right ethnic correction factors, the data generated are most of the times accurate and reproducible.

CHAPTER III

MATERIALS AND METHODOLOGY

3.1 STUDY DESIGN :

Observational, cross-sectional research design.

3.2 STUDY POPULATION

Thoracotomy patients

3.3 SAMPLE SIZE:

20 Patients

3.4 SAMPLING TECHNIQUE:

Purposive sampling method used to select the desired samples from the population of patients had Thoracotomy surgery. Samples that met inclusion-exclusion criterion had chosen by using purposive sampling technique.

3.5 STUDY SETTING:

Ashwin Multispecialty Hospital

3.6 STUDY DURATION :

6 Months

3.7 SELECTION CRITERIA:

INCLUSION CRITERIA:

- Patient who had undergone Thoracotomy
- Age of individual lies between 40-80 yrs.
- Both males and females are included in the study.
- Patients who gave their consent to take part in this study.

EXCLUSION CRITERIA:

- Individual suffering from breathing disorder are excluded.
- Malignancy of lung
- Reluctance to participate

3.8 MATERIALS USED

- Incentive Spirometer
- Stop watch
- Paper
- Pen
- Nose clip

3.9 PARAMETER

3.10 PROCEDURE OF THE STUDY:

- Patient both males and females who were admitted for Thoracotomy surgery in Ashwin Hospital and who were medically fit for the surgery according to
- surgeon were participated in the study.
- The subjects were explained about the importance and procedure of the study. An informed consent was obtained.
- Pre operative bedside pulmonary function test explained to the patient that how to perform the exercise and readings were taken.
- After that post operative bedside pulmonary function test reading will be taken and ask the patient to continue the exercise. The post operative reading were taken every day till the day of discharge.
- The difference between the readings will be compared and it will be checked that it reaches to the same level as before the surgery.
- The patients have to perform the exercise twice a day.[14]

3.11 TECHNIQUE:

1) INCENTIVE SPIROMETER:

- Patients have to be in a sitting position in a quiet room.
- Patient must be in comfortable position & in loose fitting gowns which may not restrict the chest movements and abdominal expansion.
- Data gathered prior to testing includes patient age, weight, and any chief complaint.
- Transmission of infection should be avoided by strictly adhering to hygiene and infection control manner.
- Unobstructed mouth piece: remove loose dentures if any, put mouth piece over tongue.
- Therapist explains the procedure to the patient by his own spirometer.
- Therapist asks the patient to perform the same as it done by him.
- Patient is asking to make a maximal inspiratory effort.
- Patient repeat the exercise 5-6 times till the ball is held in max inspiratory position and maximum reading will be considered.
- Proper handling and hygiene of instrument were explained.
- Patient have to perform exercise every 2 hourly.

2) BREATH HOLDING TEST:

- Patient to be in comfortable sitting position in a quiet room.
- Procedure is explained to the patient by the therapist.
- Patient is asked to take a deep breath as much as the patient can and hold the breath till he can.
- The nose clip is used to prevent any air leak.
- Patient starts holding the breath at the count of three.
- Therapist note the time by the stopwatch.
- Best of three reading is considered.
- In case of any discomfort patient inform the therapist.

Patient both males and females who are admitted for thoracotomy surgery in Ashwin Hospital and medically fit for the surgery according to surgeon met the inclusion-exclusion criteria were participated in the study during specified schedule. Twenty patients had Thoracotomy surgery recruited using purposive sampling (non-probability sampling) method from Ashwin Hospital.

Twenty subjects who had thoracotomy surgery were available for the study group had observed bedside pulmonary function test. The lung capacity (cubic centimeter/second) using incentive spirometer and breath holding time using breath holding test had collected at sampling stage one prior to Thoracotomy surgery designated as baseline observations.

At sampling stage two to four, the lung capacity and breath holding time had re-collected after Thoracotomy surgery on days 1, 3 and 7 which stored as post-intervention observations for further statistical analysis. After necessary instructions and information about the study, the subjects had explained about the complete study procedure in his/her own language and his/her willingness to participate in the study had recorded in a consent form dually signed by him/her.

The patients had analyzed before and after Thoracotomy surgery in order to evaluate the pre and post-operative bedside pulmonary function test to assess the compromised pulmonary function after surgery and to measure the improvement in pulmonary function, and may be due to administered incentive spirometer among patients had Thoracotomy surgery.

DATA ANALYSIS

The responses of frequencies were calculated and analyzed by using the raw data of 20 subjects. Microsoft excels sheet and statistical software, SPSS version 17.0 trials used for analysis. The statistical analysis of the gathered data subjected to descriptive and inferential statistics with respect to objectives of the present study.

The descriptive statistics had used to identify the features and the characteristic of the subjects while inferential statistics used to test the hypotheses in order to make a comparison in lung capacity (cubic centimeter/second) and breath holding time (second) between pre-operatively (baseline) and post-operatively on days one, third and seventh among Thoracotomy surgery patients from the gathered data.

Results on continuous measurements presented on Mean ± SD (Min-Max) while the results on categorical measurements presented in numbers or percentage. This was assumed that the observations recorded had followed a normal distribution. Therefore, a parametric test, Paired t-test used to identify the significance of mean differences in total lung capacity and breath holding time pre-operatively (baseline) and post-operatively on days 1^{st}, 3^{rd} and 7^{th} among Thoracotomy surgery patients.

Paired t-test is also applied to know the difference in lung capacity and breathe holding time post-operatively on days 1^{st}, 3^{rd} and 7^{th} between day 1 and day 3, day 1 and day 7, and day 3 and day 7.

The probability value, $p>0.05$ was considered as statistically insignificant but the probability value from $p<0.06$ to $p<0.09$ was considered as suggestively or poorly significant. The probability value from $p<0.05$ to $p<0.02$ was considered as statistically significant while from $p<0.01$ to $p<0.001$ was considered as statistically highly/strongly significant.

CRITICAL VALUES AND NOTATIONS:

Following are the notations used to present the significance of observed probability value for lung capacity and breathe holding time before and after Thoracotomy surgery.

$^{\otimes}$ Insignificant/Not Significant (p value: $p>0.05$)

$^{\wedge}$ Suggestively/Poorly Significant (p value: $p<0.09$ to $p<0.06$)

* Moderately Significant/Significant (p value: $p<0.05$ to $p<0.02$)

$^{\#}$ Highly/Strongly Significant (p value: $p<0.01$ to $p<0.001$)

CHAPTER IV

DATA ANALYSIS AND RESULTS

4.1 STATISTICAL TOOLS:

USED FORMULAE:

$$\text{Mean} = \frac{\sum_{i=1}^{n} x_i}{n}, \qquad \text{S. D.} = \sqrt{\frac{\sum_{i=1}^{n} \left(x_i - \overline{X}\right)^2}{n-1}} \qquad \text{(If } n<30\text{)}$$

$$\text{and S. D.} = \sqrt{\frac{\sum_{i=1}^{n} \left(x_i - \overline{X}\right)^2}{n}} \qquad \text{(If } n>30\text{)}$$

where $\sum_{i=1}^{n} x_i$ =Sum of all observations and

n=Number of subjects included for study according to inclusion criteria.

$\sum_{i=1}^{n} \left(x_i - \overline{X}\right)^2$ =Sum of squares of the deviations from the mean

The probability value, t-value for paired t-test had calculated by the given formula

$$t = \frac{\overline{X}}{\text{S. E. } (\overline{X})} \text{ (Degree of freedom=n-1).}$$

Wherever, the standard error of difference between means of paired samples calculated by-

$$\text{S. E. } (\overline{X}) = \frac{\text{S. D.}}{\sqrt{n}} ;$$

The organization and analysis of the findings is determined under the following tables and legends. The present chapter is dedicated to the tabulated and statistically analyzed data.

The present study entitled **"**IMPACT OF PRE AND POST OPERATIVE BEDSIDE PULMONARY FUNCTION TEST ON THORACOTOMY PATIENT" is carried out in Ashwin Hospital

Twenty cases (N=20) of Thoracotomy patients treated as study elements were purposively selected as subjects for the present study. More than three-fourth (16, 80.0%) of the patients were female selected from a total of twenty Thoracotomy (total) patients while rests (4, 20.0%) of the patients were male.

The age of all studied Thoracotomy patients obtained in the ranges from 50 to 75 years. The scatter of mean age (mean ± SD) for all patients (N=20) with surgery found to be 60.65±6.49 years.

At sampling stage one, the data for pulmonary function pre-operatively had collected prior to surgery. At second to fourth sampling stages, the data for pulmonary function had re-collected after surgery on days 1, 3 and 7 and were utilized for further statistical analysis as post-operative observations.

The following tables are showing the analyzed results with interpretations, used to achieve the aim and the objectives of the present study.

4.2 DEMOGRAPHIC DATA

TABLE 1:-

PERCENTAGE AND FREQUENCY DISTRIBUTION ACCORDING TO AGE

Age (year)	**Frequency (N)**	**Percentage (%)**
50-57	6	30.0
57-64	8	40.0
64-71	5	25.0
71-78	1	5.0
Total	**20**	**100.0**
Mean ± Standard Deviation	**60.65±6.49 year**	

Table 1 presents the distribution of age of studied patients had Thoracotomy surgery. Table showed that more than one-third (40.0%) of the patients had more frequently in the age group of 57-64 years.

Second most common age group of 50-57 years included six (30.0%) patients while five (25.0%) patients had Thoracotomy surgery noted within age group of 64-71 years.

The highest age group of 71-78 years for this study included only 1 (5.0%) patient was participated in the present study.

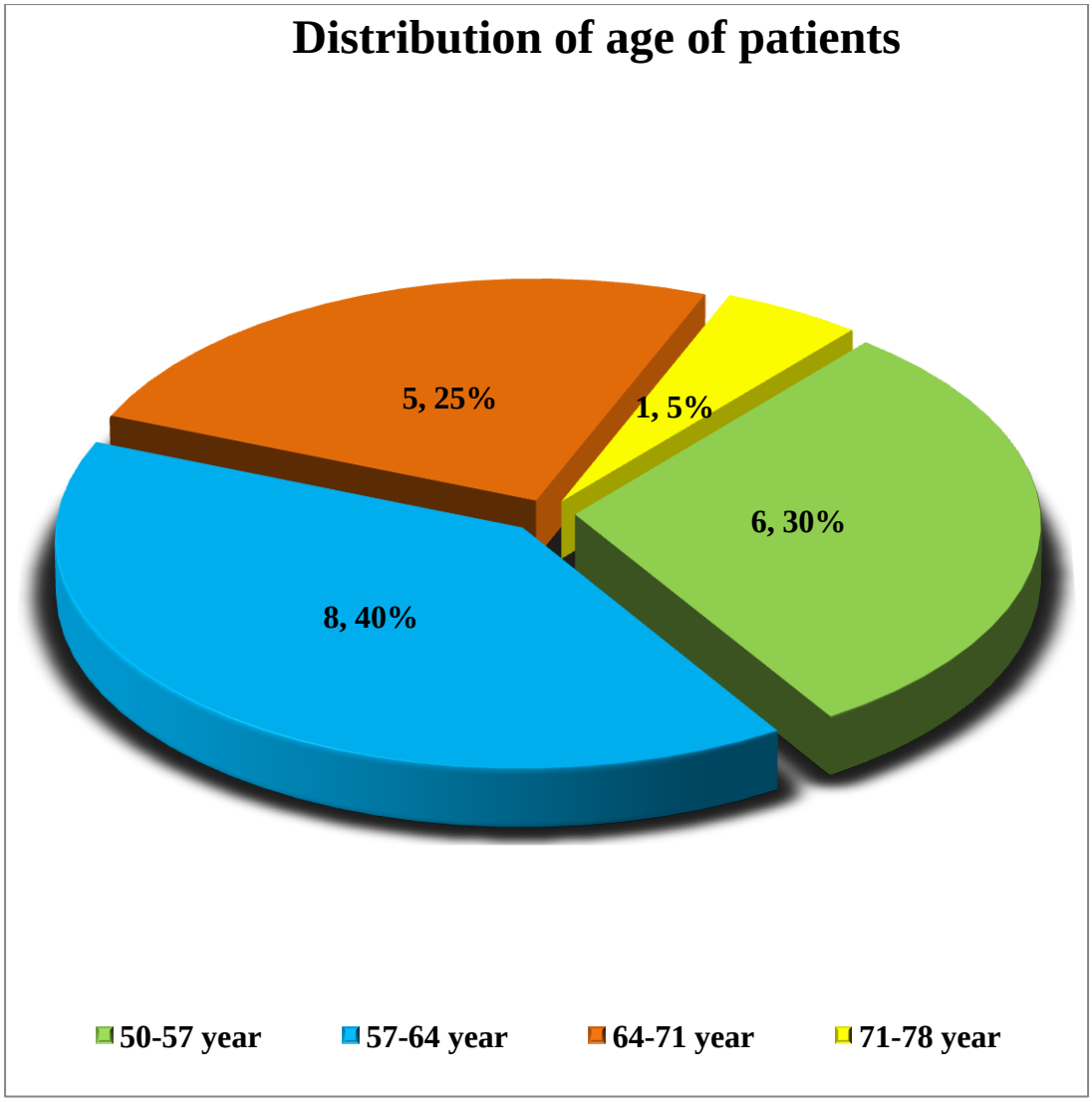

Figure 1-Sector diagram depicting the distribution of the age of studied patients had Thoracotomy surgery.

TABLE 2:-

PERCENTAGE AND FREQUENCY DISTRIBUTION ACCORDING TO GENDER

Gender	Frequency (N)	Percentage (%)
Male	4	20.0
Female	16	80.0
Total	**20**	**100.0**

The distribution of gender of studied Thoracotomy surgery patients reports in table 2.

Table indicated that more than three-fourth (80.0%) of the patients were most commonly female had selected from the population of patients had Thoracotomy surgery.

Four (20.0%) of the patients had Thoracotomy surgery found to be male had participated in the present study.

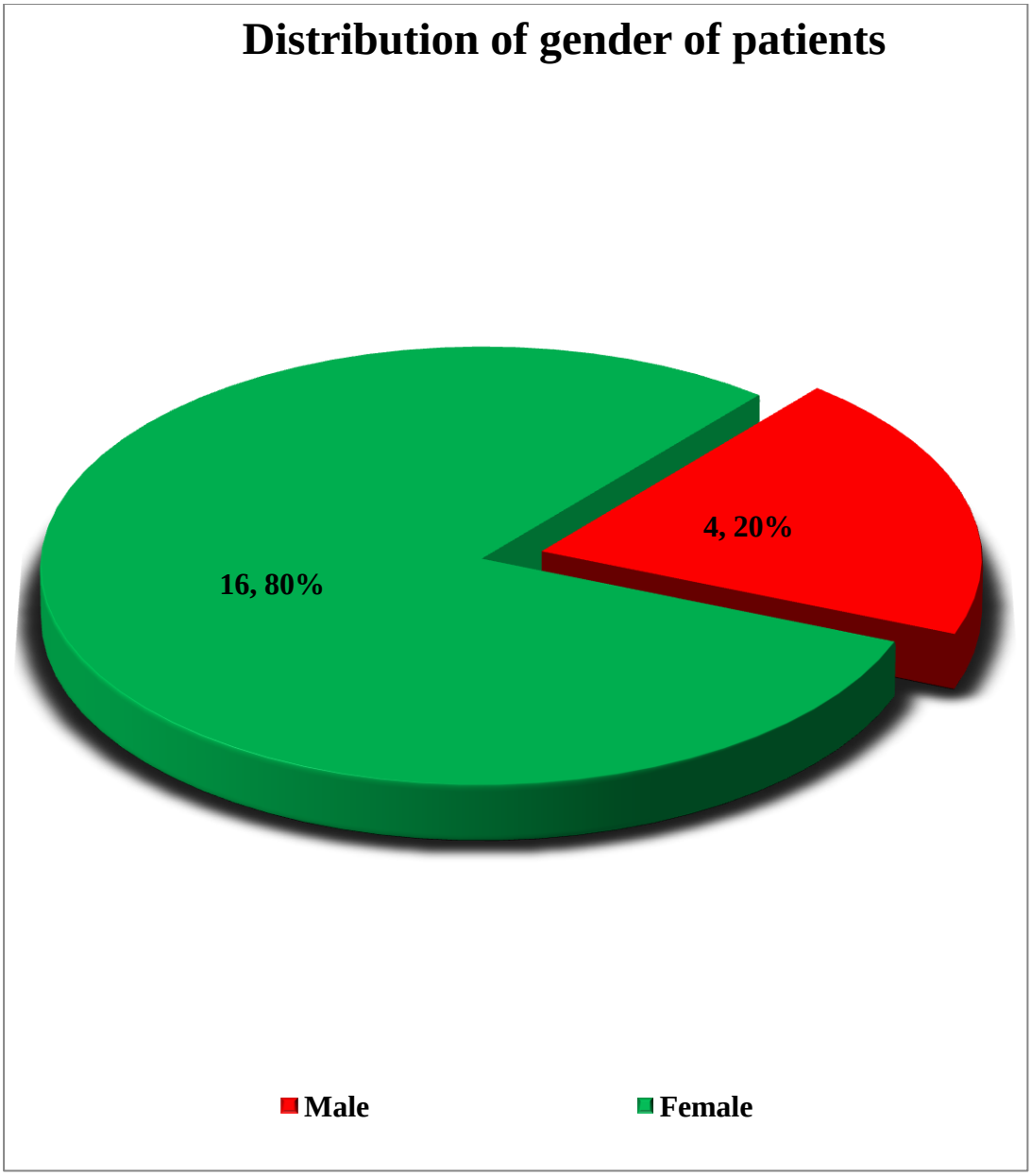

Figure 2- Sector diagram depicting the distribution of the gender of studied patients had Thoracotomy surgery.

TABLE 3:-

COMPARISON IN TOTAL LUNG CAPACITY OF PATIENTS BETWEEN PRE AND POST SURGERY ON DAY 1, DAY 3 AND DAY 7

Sampling Stage	Spread (cc/second) Mean ± SD	Mean Diff	t-statistic	LOS
Pre-operatively	1055.00±150.35	410 cc/second	7.56	p<0.001 #
Post-operatively Day 1	645.00±262.53			
Pre-operatively	1055.00±150.35	110 cc/second	2.46	p<0.03 *
Post-operatively Day 3	945.00±223.55			
Pre-operatively	1055.00±150.35	70 cc/second	2.27	p<0.05 *
Post-operatively Day 7	1125.00±133.28			

The mean differences are highly significant at the 0.001 level of significance. * The mean differences are highly significant at the 0.03 and 0.05 levels of significance. [Mean Diff-Mean Difference; LOS-Level of Significance]

Table 3 highlights that the total lung capacity pre-operatively of patients undergoing Thoracotomy surgery in bedside pulmonary function test found to be significantly differed and higher as compared to total lung capacity post operatively at day 1 and day 3 but lower as compared to day 7.

The post operatively lung capacity of patients had Thoracotomy surgery on day 1 found to be compromised significantly as compared to pre-operatively. Significant improvements noted in the total lung capacity of the patients on day 3 post operatively after use of Incentive spirometer, and on day 7 the mean total lung capacity found to be greater as compared to baseline total lung capacity.

Average (Mean ± SD) total lung capacity (1055.00±150.35 cubic centimeter/second) before surgery at sampling stage one found to be higher as compared to post-operatively total lung capacity on day 1 (645.00±262.53 cubic centimeter/second). These differences in mean total lung capacity between pre-operatively (baseline) and post-operatively (410 cubic centimeter/second) among Thoracotomy surgery patients were large and thus statistically reached at highly significant ($p<0.001$) level of significance.

After Thoracotomy surgery of studied patients, the average total lung capacity on day three (945.00±223.55 cubic centimeter/second) was increased due to administration of incentive spirometer but found to be remain little smaller and lowered as compared to pre-operative total lung capacity (1055.00±150.35 cubic centimeter/second). These differences in mean total lung capacity among patients between baseline and post-surgery on day third (110 cubic centimeter/second) were statistically significant ($p<0.03$).

Average total lung capacity on day seven (1125.00±133.28 cubic centimeter/second) of studied patients after Thoracotomy surgery found to be increased and improved as compared to pre-operative total lung capacity (1055.00±150.35 cubic centimeter/second). Differences in mean total lung capacity among patients between baseline and post-surgery on day seven (70 cubic centimeter/second) were statistically significant ($p<0.05$).

Moreover, this was inference statistically that Thoracotomy surgery patients had significantly improved total lung capacity post-surgery on day 7 as compared to pre surgery and post-surgery on days 1 and 3. Furthermore, this study reported that incentive spirometer is the effective treatment protocol may be considered as a better tool to combat the weak total lung capacity after Thoracotomy

Figure 3 presented the Box and whisker diagram showing the distribution and comparison of the total lung capacity of patients undergone thoracotomy at pre-operatively (baseline) and post-operatively on days 1, 3 and 7 using median, quartiles and error bars (95% confidence interval of mean).

The below depicted figure number three reported the differences and improvement between pre-operative lung capacity of patients and post-operative lung capacity of patients on days 1, 3 and 7.

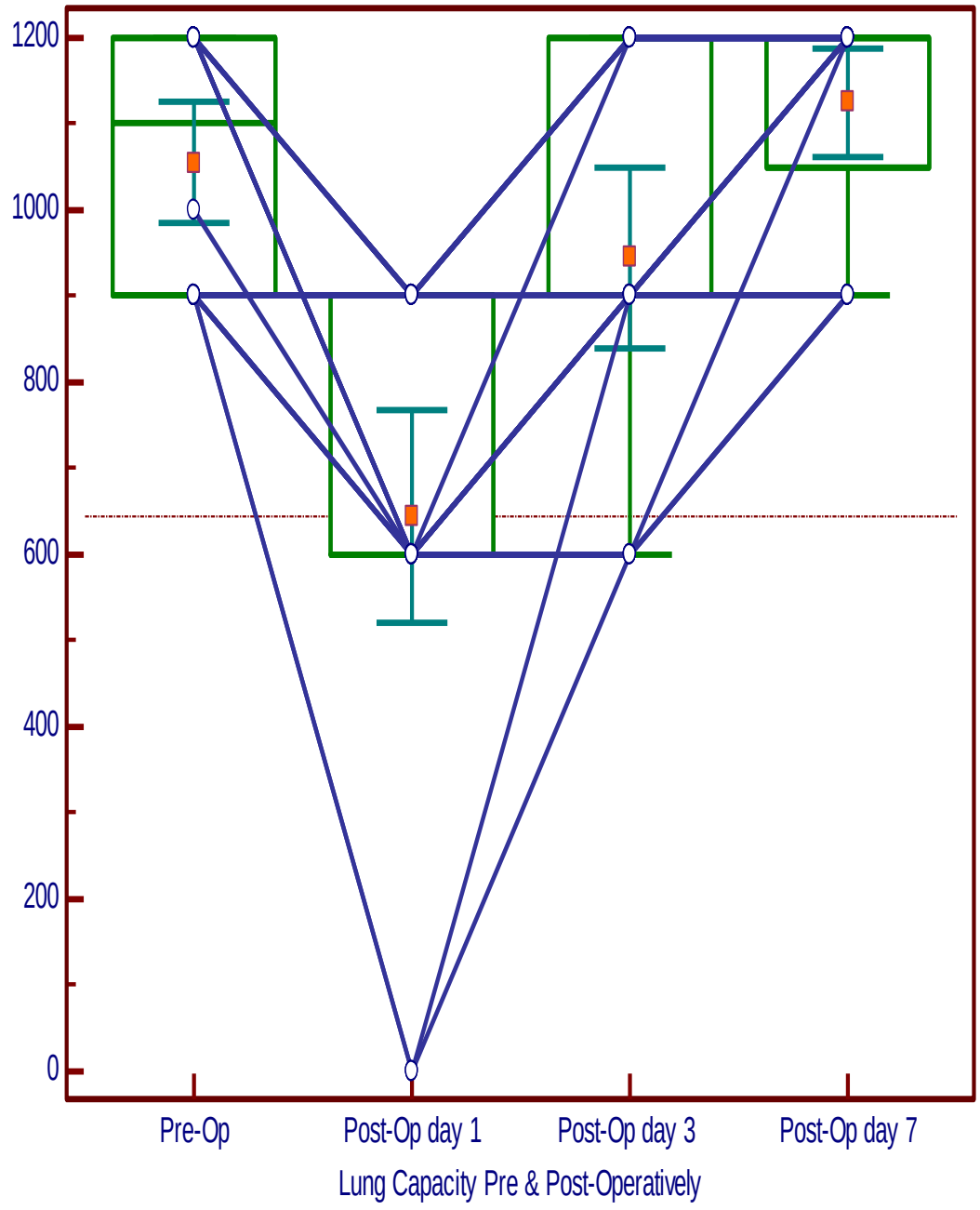

Figure 3-Box and Whisker diagram depicting the distribution of total lung capacity of patients at pre-operatively (baseline) and post-operatively on days 1, 3 and 7.

TABLE 4:-

COMPARISON IN BREATH-HOLDING TIME AMONG PATIENTS BETWEEN PRE AND POST SURGERY ON DAY 1, DAY 3 AND DAY 7

Sampling Stage	Spread (second) Mean ± SD	Mean Diff	t-statistic	LOS
Pre-operatively	31.00±6.79			
Post-operatively Day 1	19.10±5.02	11.90 second	11.84	p<0.001 #
Pre-operatively	31.00±6.79			
Post-operatively Day 3	23.55±6.34	7.45 second	5.36	p<0.03 *
Pre-operatively	31.00±6.79			
Post-operatively Day 7	31.05±7.67	0.05 second	0.04	p>0.05 ⊗

The mean differences are highly significant at the 0.001 level of significance. * The mean differences are significant at the 0.03 level of significance. ⊗ The mean differences aren't significant (insignificant) at the 0.05 level of significance. [Mean Diff-Mean Difference; LOS-Level of Significance]

Table 4 reports that the breath-holding time of patients was significantly differed and reduced after Thoracotomy surgery had noted on day1 post-operatively but improved successively after administration of incentive spirometer on day 3 and day 7 as compared to baseline stage (Pre-operatively).

Pre-operatively breath-holding time of patients undergone Thoracotomy surgery at bedside pulmonary function test found to be significantly differed and higher as compared to breath-holding time post operatively at day 1 and day 3. The post-operative breath-holding time of patients on day 1 had Thoracotomy surgery found to be compromised significantly as compared to baseline stage. Significant improvements noted in breath-holding time of the patients post-surgery on days 3, and 7. Post-surgery on day 7, the mean breath-holding time found to be little greater as compared to baseline breath-holding time.

Average (Mean ± SD) breath-holding time (31.00±6.79 second) before surgery at sampling stage one found to be higher as compared to post-surgery breath-holding time on day 1 (19.10±5.02 second). The differences in mean breath-holding time between baseline and post-surgery on day 1 (11.90 second) among patients were higher and thus confirmed statistically highly significant ($p<0.001$).

After Thoracotomy surgery, the average breath-holding time of patients on day three (23.55±6.34 second) was increased due to administration of incentive spirometer but found remain smaller and lowered as compared to pre-operative breath-holding time (31.00±6.79 second). The statistical agreement indicated that these differences in mean breath-holding time among patients between baseline and post-surgery on day third (7.45 second) were statistically significant ($p<0.03$).

Average breath-holding time on day seven (31.05±7.67 second) of studied patients after Thoracotomy surgery found to be little increased and improved as compared to pre-operative breath-holding time (31.00±6.79 second). Differences in mean breath-holding time among patients between baseline and post-surgery on day seven (0.05 second) were very little and thus couldn't reach at statistically significant ($p>0.05$) level of significance.

Moreover, the statistical agreement indicated that Thoracotomy surgery patients had significantly improved breath-holding time post-surgery on day 7 as compared to pre surgery and post-surgery on days 1 and 3.

Furthermore, this study reported that incentive spirometer is the effective treatment protocol may be considered as a better tool to combat the weak breath-holding time after Thoracotomy.

Figure 4 presented the Box and whisker diagram showing the distribution and comparison of the breath-holding time of patients undergoing Thoracotomy surgery at pre-operatively (baseline) and post-operatively on days 1, 3 and 7 using median, quartiles and error bars (95% confidence interval of mean).

The below depicted figure number three reported the differences and improvement between pre-operative breath-holding time of patients and post-operative lung capacity of patients on days 1, 3 and 7.

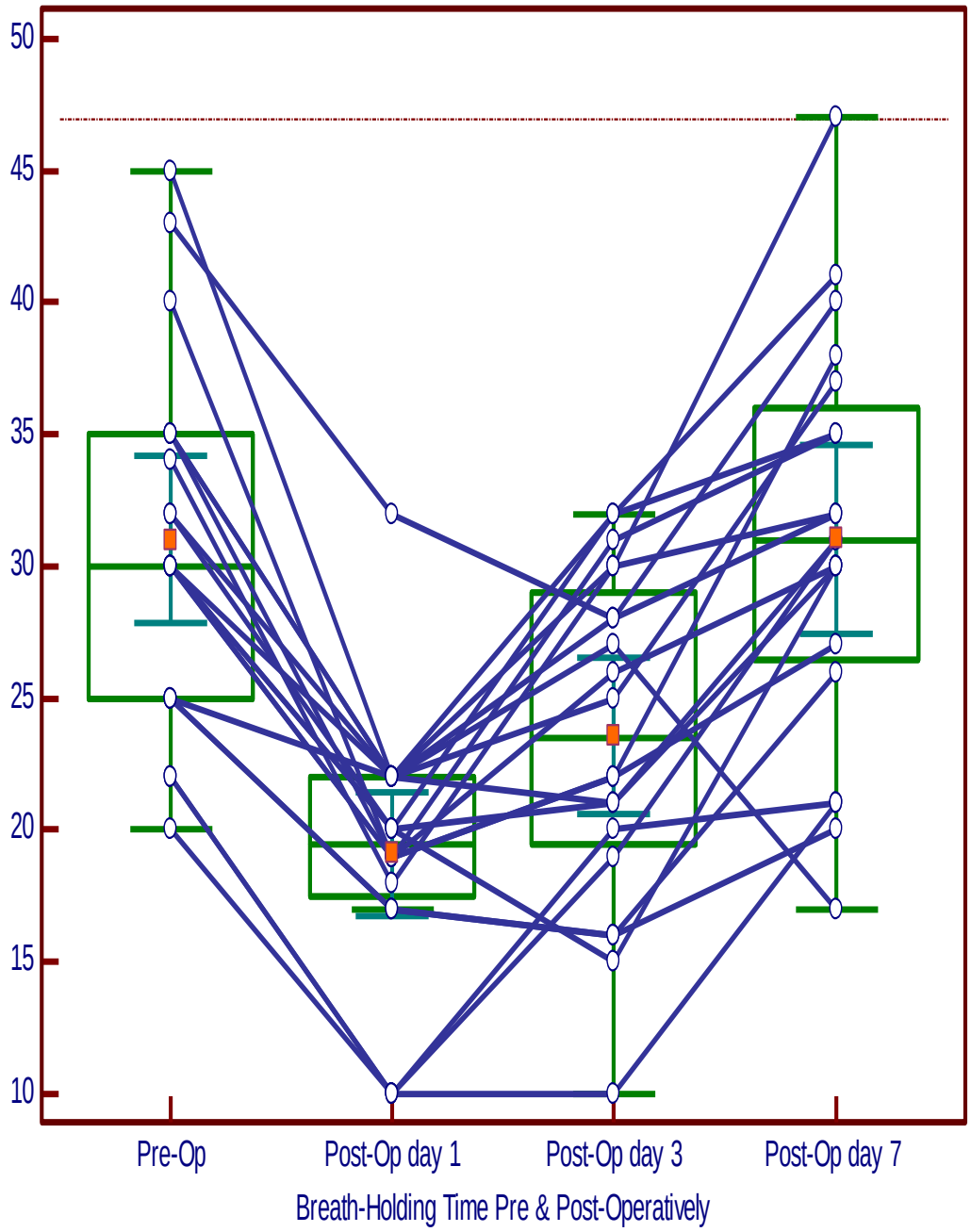

Figure 4-Box and Whisker diagram depicting the distribution of breath-holding time of patients at pre-operatively (baseline) and post-operatively on days 1, 3 and 7.

TABLE 5:-

COMPARISON IN TOTAL LUNG CAPACITY OF PATIENTS BETWEEN DAYS 1 AND 3, 1 AND 7, AND 3 AND 7 POST OPERATIVELY

Sampling Stage	Spread (cc/second) Mean ± SD	Mean Diff	t-statistic	LOS
Post-operatively Day 1	645.00±262.53	300 cc/second	6.16	p<0.001 #
Post-operatively Day 3	945.00±223.55			
Post-operatively Day 1	645.00±262.53	480 cc/second	10.51	p<0.001 #
Post-operatively Day 7	1125.00±133.28			
Post-operatively Day 3	945.00±223.55	180 cc/second	4.49	p<0.001 #
Post-operatively Day 7	1125.00±133.28			

The mean differences are highly significant at the 0.001 level of significance. [Mean Diff-Mean Difference; LOS-Level of Significance]

The total lung capacity of patients was significantly compromised after Thoracotomy surgery was reported on day 1 but after administration of incentive spirometer found

to be improved successively measured on day 3 and day 7 which can be easily seen in table 5.

Post-operatively total lung capacity of patients had Thoracotomy surgery on day 7 found to be significantly differed and higher as compared to total lung capacity post operatively on day 1 and day 3.

Post-operatively on day 3, the average (Mean ± SD) total lung capacity (945.00±223.55 cubic centimeter/second) of patients found to be increased as compared to post-operatively total lung capacity on day 1 (645.00±262.53 cubic centimeter/second). These differences in mean total lung capacity between day 1 and day 3 (300 cubic centimeter/second) post-operatively among patients had Thoracotomy surgery were statistically highly significant ($p<0.001$).

Average total lung capacity on day seven (1125.00±133.28 cubic centimeter/second) of studied patients after Thoracotomy surgery was increased at large as compared to total lung capacity on day 1 (645.00±262.53 cubic centimeter/second) post-operatively. At post-surgery, these differences in mean total lung capacity among patients between day seven and day one (480 cubic centimeter/second) were statistically highly significant ($p<0.001$).

Average total lung capacity on day seven (1125.00±133.28 cubic centimeter/second) of studied patients after surgery found to be increased and improved as compared to post-operative total lung capacity on day three (945.00±223.55 cubic centimeter/second). Post-surgery differences in mean total lung capacity of patients between day seven and day three (180 cubic centimeter/second) were highly significant ($p<0.001$).

Henceforth, the statistical agreement indicated that on day seven the Thoracotomy surgery patients noted with significantly improved total lung capacity post-operatively as compared to day one and day three. Furthermore, results showed that incentive spirometer is the effective treatment protocol may be considered as a better tool to combat the weak total lung capacity after Thoracotomy

Figure 5 presented the Box and whisker diagram showing the distribution and comparison of the total lung capacity of patients undergone Thoracotomy surgery post-operatively on days 1, 3 and 7 using median, quartiles and error bars (95% confidence interval of mean).

The below depicted figure number three reported the differences and improvement in the total lung capacity of patients post-operatively on days 1, 3 and 7.

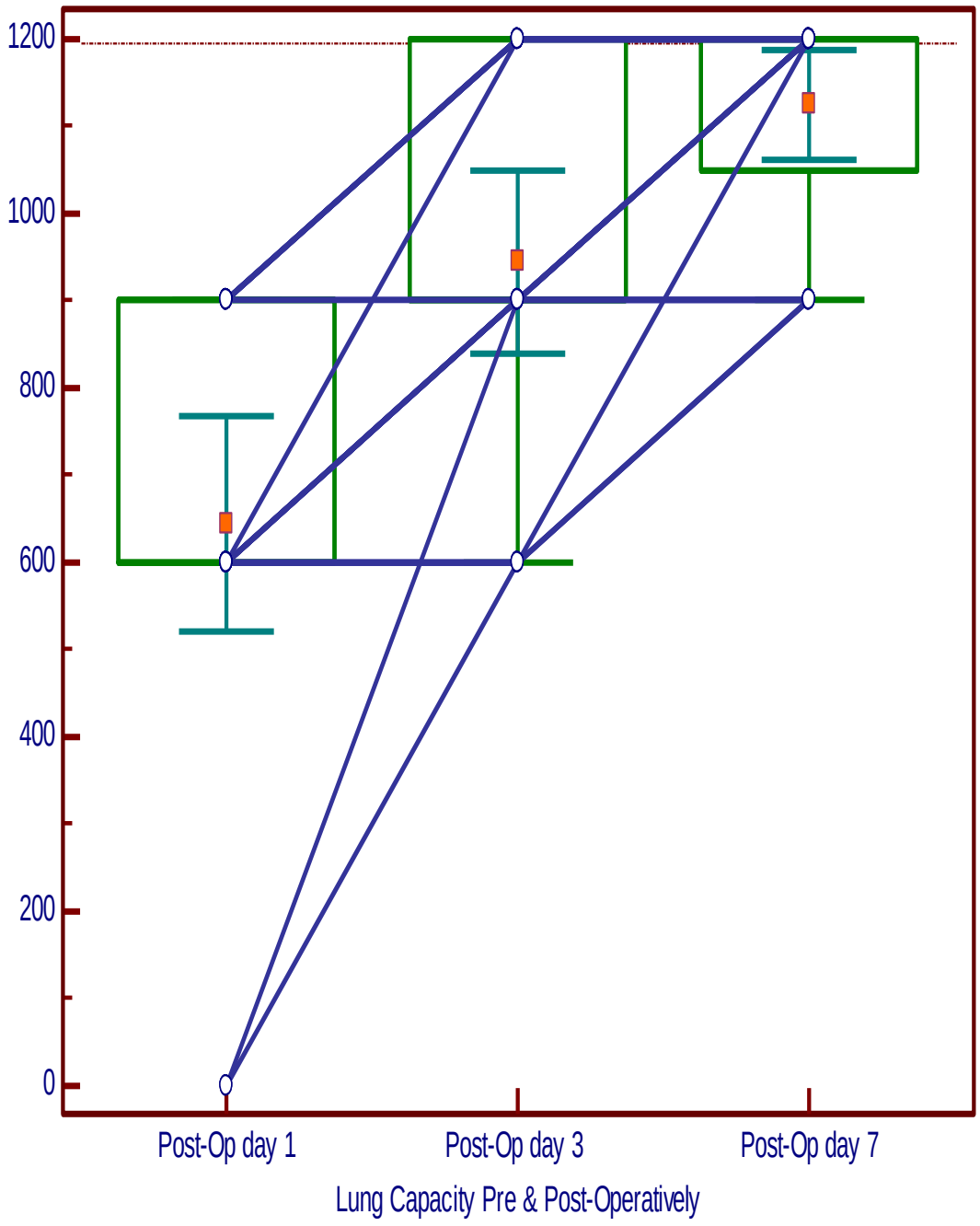

Figure 5-Box and Whisker diagram depicting the distribution of total lung capacity of patients post-operatively on days 1, 3 and 7.

TABLE 6:-

COMPARISON BETWEEN DAYS: 1 AND 3, 1 AND 7, AND 3 AND 7 IN BREATH-HOLDING TIME OF PATIENTS POST OPERATIVELY

Sampling Stage	Spread (second) Mean ± SD	Mean Diff	t-statistic	LOS
Post-operatively Day 1	19.10±5.02	4.45 second	3.66	p<0.001 #
Post-operatively Day 3	23.55±6.34			
Post-operatively Day 1	19.10±5.02	11.95 second	8.01	p<0.001 #
Post-operatively Day 7	31.05±7.67			
Post-operatively Day 3	23.55±6.34	7.50 second	5.29	p<0.001 #
Post-operatively Day 7	31.05±7.67			

The mean differences are highly significant at the 0.001 level of significance. [Mean Diff-Mean Difference; LOS-Level of Significance]

Table 6 reveals that the breath-holding time of patients found to be significantly smaller after Thoracotomy was noted on day 1 post-operatively but after

administration of incentive spirometer found to be rose and improved successively recorded on day 3 and day 7.

Breath-holding time of patients had Thoracotomy found to be significantly differed and higher post-operatively on day 7 as compared to day 1 and day 3.

Post-operatively on day 3, the average (Mean ± SD) breath-holding time (23.55±6.34 second) among patients was rose as compared to post-operatively breath-holding time on day 1 (19.10±5.02 second). These differences in mean breath-holding time between day 1 and day 3 (4.45 second) post-operatively among patients had Thoracotomy were statistically highly significant ($p<0.001$).

Average breath-holding time on day seven (31.05±7.67 second) of patients after Thoracotomy was increased at large as compared to breath-holding time on day 1 (19.10±5.02 second) post-operatively. At post-surgery, these differences in mean breath-holding time among patients between day seven and day one (11.95 second) were statistically highly significant ($p<0.001$).

Increases and improved average breath-holding time of studied patients noted on day seven (31.05±7.67 second) post-surgery as compared to post-surgery breath-holding time on day three (23.55±6.34 second). Post-surgery differences in mean breath-holding time of patients between day seven and day three (7.50 second) were highly significant ($p<0.001$).

The statistical agreement indicated that on day seven the Thoracotomy patients had significantly improved breath-holding time post-operatively as compared to day one and day three.

Overall, results of present research documented that incentive spirometer is the effective treatment protocol may be considered as a better tool to combat the weak breath-holding time after Thoracotomy.

Figure 6 presented the Box and whisker diagram showing the distribution and comparison of the breath-holding time of patients undergoing Thoracotomy post-operatively on days 1, 3 and 7 using median, quartiles and error bars (95% confidence interval of mean).

The below depicted figure number three reported the differences and improvement in breath-holding time of patients post-operatively on days 1, 3 and 7.

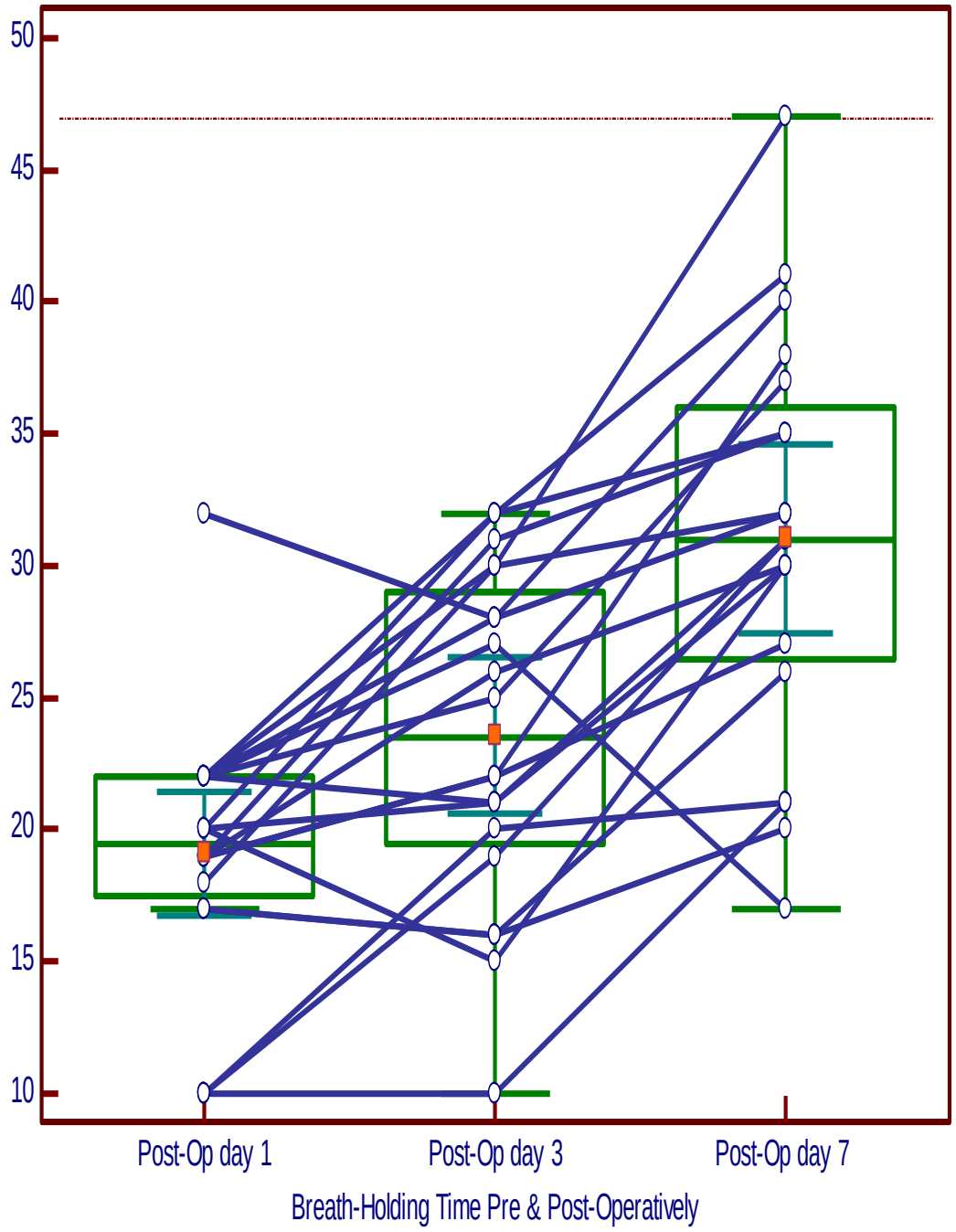

Figure 6-Box and Whisker diagram depicting the distribution of breath-holding time of patients post-operatively on days 1, 3 and 7.

Furthermore, this was concreted statistically that patients had Thoracotomy found with compromised total lung capacity and breath-holding time. Therefore, administration of incentive spirometer after Thoracotomy found to be advantageous

among patients and the patients had significantly improved total lung capacity and breath-holding time to overcome post-surgery difficulties in pulmonary functioning.

Overall, present research reported that the incentive spirometer is an effective conservative treatment protocol after Thoracotomy survivors to improve lung capacity and breath-holding time.

Finally, the above all statements and inferences from all the tables indicated the rejection of null hypothesis. Therefore, the alternative hypothesis is accepted which stated as "There will we significant effect on pulmonary function before and after the Thoracotomy" and that impacted the achievement of the entire selected objectives followed with fulfillment of the aim of the proposed research entitled **"IMPACT OF PRE AND POST OPERATIVE BEDSIDE PULMONARY FUNCTION TEST ON THORACOTOMY PATIENT"**.

CHAPTER V

DISCUSSION

The purpose of the study is to provide beneficial effects of bedside pulmonary function in a variety of surgical fields. Overall, it may seems that PFT is beneficial both pre operatively and post operatively.

Twenty subjects who had thoracotomy were available for the study group had observed bedside pulmonary function test. The measurement like lung capacity (cubic centimeter/second) using incentive spirometer and breath holding time using breath holding test were conducted prior to thoracotomy and these data obtained were designated as baseline observations.

The lung capacity and breath holding time were re-collected after thoracotomy on days 1, 3 and 7.There data were stored as post-intervention observations for further statistical analysis.

Moreover, this was infered statistically that thoracotomy patients had significantly improved total lung capacity post-surgery on day 7 as compared to pre surgery and post-surgery on days 1 and 3.

Thus, results showed that incentive spirometer is an effective treatment protocol which may be considered as a better tool to combat the weak total lung capacity after thoracotomy

The main reason for lack of compliance, especially on the first **postoperative** day, may be that patients often experience pain, lack of activity drive, and residual sedation from anesthesia in the first 24 hours after surgery. Such fatigue and pain may limit a patient's motivation and ability to use the incentive spirometry device. Based on this fact, one would expect an increase in spirometry use as patients recover from their fatigue and pain, an expectation supported by the current study data: each subsequent postoperative day had statistically higher compliance with incentive spirometry use than the previous day.[(20)]

.Patient suffering from pain in other joints were also more likely to have a poor post-operative physical well being and subclinical improvement.[16]

Guide line recommended that preoperative spirometry is useful. The newer generation spirometer are simpler to use and both patient and therapist friendly.[18]

To the author's knowledge, no studies in orthopaedic literature analysed the extent of incentive spirometer use in orthopaedic patient population or the factor that are correlated with patient compliance in using the incentive spirometry device. The author hypothesized that use of such devices by orthopaedic patient is far less than the recommended level and is affected by patient age and sex, surgery type and postoperative day and time.[19]

In study by Mesfin A.Lemma et al consecutive patient undergone thoracotomy incentive spirometry use was far less than what is recommended: only one patient in 10 met the recommended usage level, only 1 in 6 patient used the device > 7 times per hour and approximately one third of patient used the device <2 times per hour or not at all. Multiple reasons were hypothesized for the poor compliance observed in the study.[20]

Age and sex were not correlated with incentive spirometry use, and a distinct subpopulation of patients (32% of all patients) stayed noncompliant (<2 uses of the incentive spirometry device per hour) during their entire hospital stay. Several reasons may exist for this finding: (1) they may have had higher levels of pain or fatigue than their compliant peers; (2) they may not have received an adequate understanding of the benefits of incentive spirometry use during their preoperative education session; and (3) they may not have received adequate in-hospital encouragement to use the incentive spirometry device provided.[15]

Breath-holding time of patients had thoracotomy found to be significantly differed and higher post-operatively on day 7 as compared to day 1 and day 3.

Furthermore, this was concluded statistically that patients who had undergone thoracotomy had compromised total lung capacity and breath-holding time. Therefore, immidiate administration of incentive spirometer after thoracotomy found

to be advantageous among patients as they had significantly improved total lung capacity and breath-holding time to overcome post-surgery difficulties in pulmonary functioning.

In some study by Lingard et al comparing the patient from a centre in Montreal, Quebec, Canada and a centre in Boston, Massachutts, important difference between two centre were identified with respect to the preoperative status of patients. Preoperative PFT was the strongest determinant of functional outcome at six month and two years following thoracotomy. They hypothesized that there would be a significant difference in pain and functional status at the time of the preoperative assessment among the patient after adjusting for independent covarities.[15]

In study by Larsen et al. also found that although a thoracotomy seems to restore a patient's quality of life, it does not restore their general physical wellbeing to that of the accepted population norm. This has been acknowledge by Becker et al. Starting that "the success of thoracotomy does not rely soley on thoracotomy[16]

There is no doubt that pulmonary function test plays an important role in diagnosis, management and followup.[14]

The average (Mean ± SD) total lung capacity (1055.00±150.35 cubic centimeter/second) before surgery found to be higher as compared to post-operatively total lung capacity on day 1(645.00±262.53 cubic centimeter/second) and 3(945.00±223.55 cubic centimeter/second). On day 7 the TLC (1125.00±133.28 cubic centimeter/second) of studied patients after thoracotomy found to be increased and improved as compared to pre-operative total lung capacity .

The (p value) of post-operative total lung capacity on day 1, 3 and 7 is statistically significant ($p<0.001$) ($p<0.03$) and ($p<0.05$) respectively.

The average (Mean ± SD) breath-holding time (31.00±6.79 second) before surgery found to be higher as compared to post-surgery breath-holding time on day 1 (19.10±5.02 second) and day 3 (23.55±6.34 second). The (p value) of post-operative breath-holding time on day 1 and 3 is statistically significant ($p<0.001$) and ($p<0.03$) respectively.

Average breath-holding time on day seven (31.05±7.67 second) of studied patients after thoracotomy found to be little increased and improved as compared to pre-operative breath-holding time (31.00±6.79 second). However couldn't reach at statistically significant ($p>0.05$) level of significance.

In present study it has been seen that bedside PFT is helpful in enhancing the quality of life of the patient and reduce the days of stay in hospital. It imply that increase in vital capacity of the lungs and increase in holding capacity helps the patient to recover faster.

Boysen and Blok AJ Suggested found that those patients who undergo lobectomy may transiently lose considerably more pulmonary function than would certainly be anticipated from the amount of tissue resected.

While J Richardson S Sabanathan found that Pulmonary function was better preserved in the paravertebral group who had higher oxygen saturation and less postoperative respiratory morbidity

Chin-Tung Lau Kenneth found that long term PFT result following thoracoscopic lobectomy is better than open lobectomy, This may be due to impaired respiratory musculature after thoracotomy

Michel S Kent and Sumithra found that clinically meaningful decline in pulmonary function occurred after lower lobe resection and after thoracotomy at 3 months but subsequently recovered

CHAPTER VI

SUMMARY

Also, the incentive spirometer is an effective conservative treatment protocol after thoracotomy survivors to improve lung capacity and breath-holding time.

CONCLUSION

Overall, statistical data analysis concluded that there is significant reduction in pulmonary function on 1st and 3rd Post operative day (lung capacity and breath holding time) after Thoracotomy.

CHAPTER VII

LIMITATIONS

1. The present study had a few limitations, like; the sample study was small.

2. Difference in intra-operative anesthesia medication as well as amount of postoperative analgesia used may have suppressed lung function.

3. Patient with postoperative delirium was not included in the study.

SUGGESTIONS

1. Future study can be based upon a relatively larger sample that is more representative of the population.

2. Further study can be done on patients with other surgical Procedures.

3. It would be better if clinical spirometery is used for evaluation in this study

.

CHAPTER VIII

REFERENCES

1. Efficacy of incentive spirometer exercise on pulmonary functions of patients with ankylosing spondylitis stabilized by tumor necrosis factor inhibi... PubMed 2012 Sep;39(9):18548.
2. Lawrence G. Lenke .Results of preoperative pulmonary function testing of adolescents with idiopathic scoliosis: A study of six hundred and thirty-one patients Peter O. Newton Children's Hospital San Diego Frances D. Faro Children's Hospital San DiegoSohrabGolloglyChildren's Hospital San Diego Randal R. Betz Shriner's Hospital for Children – Philadelphia
3. D'Lima, Darryl D The effect of preoperative exercise on thoracotomy May 2016 :326:174-182
4. Simon JP Devos Welters H, Jansen IJ a restrospective study of 70 patients 2015 :Vol 68 :Issue -3 235-41
5. Hamid Hassanzadeh, MD Amit jain, BS Eric W Tan MD Benjamin E Stein MD Megam L Van Hoy RN Nadine N Stewart RN Mesfin aA Lemma MD post operative Incentive spirometry June 2015 : 35:6
6. Sjaak pouwels, David Hageman,Lindy N M Gommans, Edith M Willigendael Simon W Nienhuijs , Marc R Schelitinga, Joep A,W Teijink. Preoperative exercise therapy in surgical care : a scoping review :journal of Clinical anesthesia June 2016 :33, 476-490
7. Karin Valkenet Ingrid GL van de Port The effects of preoperative exercise therapy on postoperative thoracotomy :a systematic review: clinical rehabilitation 2015:25:99-111
8. Choudhary sumer pulmonary function test in clinical practice: Importance requirement and limitations January – June 2013 3:1 7-2
9. Lingard, Elizabeth A katz jeffrey N Write Eilzabeth A Sledge Clement B Predicting the outcome of thoracotomy Oct 2015 :86 10:2179
10. N.D Clement R Burnett Patient satisfaction after thoracotomy is affected by genetal physical well being Surg Sports Traumatol Arthrosc 2015 :21:2638-2646

11. Iverson LI Ecker RR Fox HE A Comparative study of IPPB the incentive spirometer and blow bottles the prevention of atelectasis following cardic surgery March 2016 25: 3 197-200
12. Robert H Bartlett, MD alan B Gazzaniga MD Tamar R Geraghty RN Respiratory Maneuver to prevent Post operative pulmonary complications A Critical review JAMA may 2016 224 :7 : 1017- 1021
13. Peter O Newton Results of Preoperative pulmonary function testing of adolescences with idiopathic scoliosis : A study of six hundred and thirty one patients , Children Hospital Diego 2016 :1073 : 1937- 1946
14. Lippincott Williams & Wilkins ,Incentive spirometry does not enhance recovery after thoracic surgery :Critical care Medicine :2002: 28:3
15. Czaplicki AP Borger JE Politi JR Chambers BT Taylor BC J Arthroplasty Evaluation of postoperative fever and leukocytosis in patients after thoracotomy Dec 2015 : 26; 8 :1386-9
16. Schoenfeld AJ Ochoa LM Bader JO Belmont PJ jr Am Risk Factor for immediate post operative complications following spine surgery National surgical quality improvement program Sep 2014 93: 17 :1577 -82
17. Weindler J Kiefer RT the efficacy of postoperative incentive spirometry is influenced by devise specific imposed breathing June :119:67: 1858-64
18. Overend TJ Anderson CM Lucy SD C Bhatia C Jonsson BI Timmernans C The effect of the incentive spirometry on Postoperative pulmonary complications a systematic review Sep 2015 :120:3 971-8
19. Galal Ghaly MD,Mohmend Kamel MD, Abu Nasar MS,The Annals of thoracic surgery, Vol 101, issue 2, Feb 2016, pg 465-472.
20. Rodrigo B, Interiano, Sue C Kaste, Chenghong , Journal of cancer survivorship Oct 2017, VOl 11, Issue 5,PP 553-561.
21. Daniel almquist Nabin Khanal, International journal of cancer research and treatment May 2018vol 38, no 5, 2903-2907
22. Fransis Ali Osaman, Alisia Mangram, Joseph Sucher, The American journal of Surgery, vol 216 issue 1, july 2018 page 46-51.
23. Ran Macke , Mathew j Schuchert , David d odell, journal of cardiothoracic surgery 2015, 10:49
24. Lehman, Ronald ,Kang Daniel,Jeremy,The journal of bone and joint surgery january 2015Volume 97Issue 1 page 32-39

25. Sue Jenkins chapter 10 patients problem management and outcome may 2016
26. James C latrids, James kang Rita Kandel, Journal of orthpedic research 35,1,(5-7) 2017
27. Colin F Mackenzie Chapter 8 Chest Physiotherapy for special patient " Physiotherapy in the intense care unit – Second edition
28. David A Lipson Chapter 245 Aproach to the patient with disease of the respiratory system Harrison'Principle of Internal medicine –Seventh edition
29. W Darlus Reid Chapter 7 Pulmonary Function test
30. Donna Frownfelter Chapter 8 Pulmonary function test Principles and practice of cardiao pulmonary therapy third edition
31. Zara Cohen Chapter 20 Pulmonary function testing Egans Fundamental of respiratory care –Eleventh edition
32. Richard H Kallet Chapter 16 Bedside assessment of patient Egans Fundamentals of respiratory care Eleventh edition
33. Karl T Weber Kenin P Neuman Chapter 34 Principles and application of cardiopulmonary exercise testing Fishman's Pulmonary disease and disorder Fifth edition
34. Carolyn Kishner Lymn Allen Colby Chapter 25 Management of Pulmonary Condition Fifth edition
35. Richardson Sabanathan BJA British journal of Anaesthesia, Vol 83, Issue 3,1 September 2016 ,Pages 387-392
36. Chin –Tung Lau Kenneth Journal of Pediatric surgery Volume 53, Issue 12, December 2018, Pages 2383-2385
37. Michel S Kent and Sumithra , The Anals of thoracic surgery, Volume 102, Issue 1, July 2016 Pages 230-238

CHAPTER-IX

ANNEXURE-I

INFORMED CONSENT FORM

TITLE: "IMPACT OF PRE AND POST OPERATIVE BEDSIDE PULMONARY FUNCTION TEST ON THORACOTOMY PATIENT – A COMPARATIVE STUDY "

INVESTIGATOR:

CO-INVESTIGATOR:

PURPOSE OF THE STUDY:

I ---------- have been informed that is study will help clinicians and therapists to find out the effectiveness of floor and aquatic exercise on improving functional capacity and forced expiratory volume.

PROCEDURE:

I ---------- understand that I will undergo experiments with ---------- Under the direct supervision of coach. I am aware that I have to follow therapist's instruction as has been told to me.

RISK AND DISCOMFORT:

I ---------- understand that there are no potential risks associated with this procedure, and understand that ------ will accompany me during this procedure.

CONFIDENTIALITY :

I ---------- understand that the medical information produced by this study will be confidential. If the data are used for publication in the medical literature or for teaching purpose, no name will be used and photographs will be used without identify for publication and presentation.

REQUEST FOR MORE INFORMATION:

I ---------- understand that I may ask any question about the study at any times…… are available to answer my question. Copy of this concern form will be given to me keep for my careful reading.

REFUSAL OR WITHDRAWAL OF PARTICIPATION:

I ……understand that my participation is voluntary and I may withdraw consent and discontinue participation at any time after he has explained the reasons for doing so.

INJURY STATEMENT:

I ……..Understand that the diagnosis/ treatment procedure, under the guidance of my therapist, is likely to cause any/ no injury. In such case medical attention will be provide, but in compensation will be provide.

I understand my agreement to participation in this study and I am not waiving any of my legal rights. I …… confirm that …… have explained me the purpose of the study procedure and possible risk that it may experience. I have read and I have understood this concern to participate as a subject in this study……

……. ……

SUBJECT **DATE**

……. ……

WITNESS TO SIGNATURE **DATE**

I have explained……. The purpose of the research, the procedure required and the possible risks and benefits, to the best of my ability.

Investigator's Signature

Investigator's Name

ANNEXURE –II

RESPIRATORY ASSESSMENT FORM

SUBJECTIVE EVALUATION

NAME	
AGE GENDER HEIGHT WEIGHT BMI	
OCCUPATION	
CHIEF COMPLAINTS	
DURATION OF CONDITION	
PAST MEDICAL HISTORY	
PRESENT MEDICAL HISTORY	
FAMILY HISTORY	
DRUG INTAKE	

OBJECTIVE ASSESSMENT

A. DYSPNOEA

ON STERNOUS ACTIVITY	
ON ORDINARY ACTIVITY	
ON MILD EXERTION	
AT REST	

B.WHEEZE

DIURNAL VARIATIONS	
AGGERVATING FACTORS	
POSTURAL VARIATIONS	

C.COUGH

DRY/PRODUCTIVE	

D.SPUTUM

COLOUR	
CONSISTANCY	

ON OBSERVATION	
BODY BUILT	
BREATHING PATTERN	
USE OF ACCESSORY MUSCLE	
CYANOSIS	

VITAL SIGNS

TEMPERATURE	
RESPIRATORY RATE	
BLOOD PRESSURE	
PULSE RATE	

ON EXAMINATION

A.BREATHING PATTERN

RATE	
DEPTH	
RHYTHUM	
CHEST WALL EXPANSION	

B.CHEST WALL CONFIGURATION

PECTUS EXCAVATUM	
PECTUS CARINATUM	
FLIAL CHEST	

C. ON PALPATION

SYMMETRY OF CHEST MOVEMENT	
MUSCLE SPASM	
TACTILE FREMITUS	
TRACHEALDEVIATION	

D.ON PERCUSSION

RESONANT	
HYPER RESONANT	
DULL	
FLAT	

E.ON AUSCULTATION

A. BREATH SOUNDS	
NORMAL	
ABNORMAL	
ADVENTITOUS	
B. HEART SOUNDS	

INVESTIGATION

PULMONARY FUNCTION TEST	FVC
	FEV 1
	FEV 1 / FVC
	PEFR
ARTERIAL BLOOD GAS ANALYSIS	
CHEST X RAY	

DIAGNOSIS				
AIM OF TREATMENT				
MEANS OF TREATMENT				
WHEATHER THE PATIENT IS SELECTED	YES		NO	
FOR STUDY				
IF YES	GROUP A		GROUP B	

ANNEXURE –III

Sr. no.	Age (y)	Sex	Incentive Spirometry cc/sec					BHT(sec)			
			PRE	Post-Op 1	Post-Op 3	Post-Op 7		PRE	Post-Op1	Post-Op3	Post-op7
1	61	F	1200	900	1200	1200		30	20	32	41
2	54	F	1000	600	900	900		22	10	10	21
3	75	M	900	600	600	1200		25	22	28	32
4	65	F	900	600	900	1200		25	17	16	26
5	67	F	1200	600	900	1200		25	17	16	20
6	61	F	900	900	1200	1200		43	32	28	40
7	63	F	1200	900	900	1200		35	19	26	30
8	68	F	1200	600	900	1200		30	19	22	27
9	58	F	900	600	600	900		32	22	21	31
10	50	F	1200	600	900	1200		32	20	21	30
11	64	M	1200	900	1200	1200		40	19	22	38
12	55	F	900	600	600	900		20	10	19	31
13	55	F	900	0	600	900		30	20	15	30
14	62	F	1200	600	1200	1200		35	22	25	37
15	60	M	900	900	1200	1200		45	22	30	47
16	55	F	900	0	900	900		35	22	32	35
17	60	M	1200	900	1200	1200		34	18	30	32
18	70	F	1200	600	900	1200		30	22	27	17
19	60	F	900	600	900	1200		22	10	20	21
20	50	F	1200	900	1200	1200		30	19	31	35

PHOTOGRAPHIC PRESENTATION

PHOTOGRAPHIC PRESENTATION